Audi
Truth in Engineering

FUEL FOR THOUGHT

01 | 2014 → TDI® clean diesel

2014 | TDI

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Understanding the upside of diesel can take a whole day.

Sometimes consumers understand the benefits of Audi TDI® clean diesel immediately. Through their research, they've found that today's Audi TDI® clean diesel engines all but sip the fuel and emit less CO_2 than their gasoline equivalents.[1] They may have heard that the torque response in our diesel engines helps you feel every bit of the broad torque band of true Audi performance.[2] Other people might need a test drive to confirm the facts, or need a whole brochure like this one. As for the skeptics, the ones who remember diesel engines from the sooty old days of charcoal-black smoke and stuttering spasms of acceleration, we want to give them a full day to help them see the upside of innovation. Like the 24 Hours of Le Mans. Not surprisingly, given their power and fuel efficiency, Audi racecars have regularly won this prestigious performance and endurance race, and the Audi R10 TDI® was the first diesel-powered vehicle to win, in 2006. Since then, Audi TDI® diesel engines in our R15 and R18 racecars have continued to win motorsports' most grueling race, despite rules designed specifically to counteract their inherent advantages.

Audi R18 TDI®_

3.7-liter V6 TDI® engine_

Victory in the 24 Hours of Le Mans on June 11, 2011_

Audi TDI® technology has won six Le Mans titles since 2006.

1 See www.fueleconomy.gov for EPA estimates. Your mileage may vary. 2 Obey all speed and traffic laws.

Photo by William Moore

We're just importing continental values.

Democracy. Style. The Enlightenment. It's no secret that America has been importing new refinements and innovations from Europe since there's been an America. We think Americans are ready for the next big idea: TDI® clean diesel. With the largest lineup of diesel vehicles in the luxury class[1], we're making a strong statement that we think TDI® clean diesel will jump the pond for the same reasons Europeans have turned to it: value and performance. Given its power density and efficiency,[2] it should go without saying that diesel is a top choice due to the cost of fuel, which, while higher in Europe, is a concern here too. But diesel is also the top choice in places like Germany as well, which prizes performance as much as efficiency, as anyone who has ever driven the autobahn knows. So maybe those millions of Europeans who own a diesel vehicle are onto something. At a time when Americans are looking for more efficient options, this European favorite might just be the latest refined innovation from the Continent.

EUROPEAN DIESEL CAR SALES SHARES IN 2011[4]

1

BELGIUM[3]

75.9%

10.840 million inhabitants[5]
5.276 million passenger cars on the road[5]
153 vehicles per square km[6]

2

NORWAY

74.9%

4.799 million inhabitants[5]
2.309 million passenger cars on the road[5]
Highest HDI rating: 0.943[7]

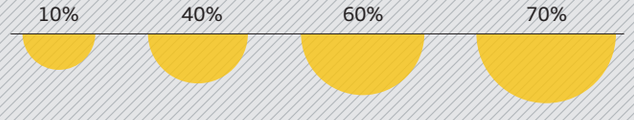
3

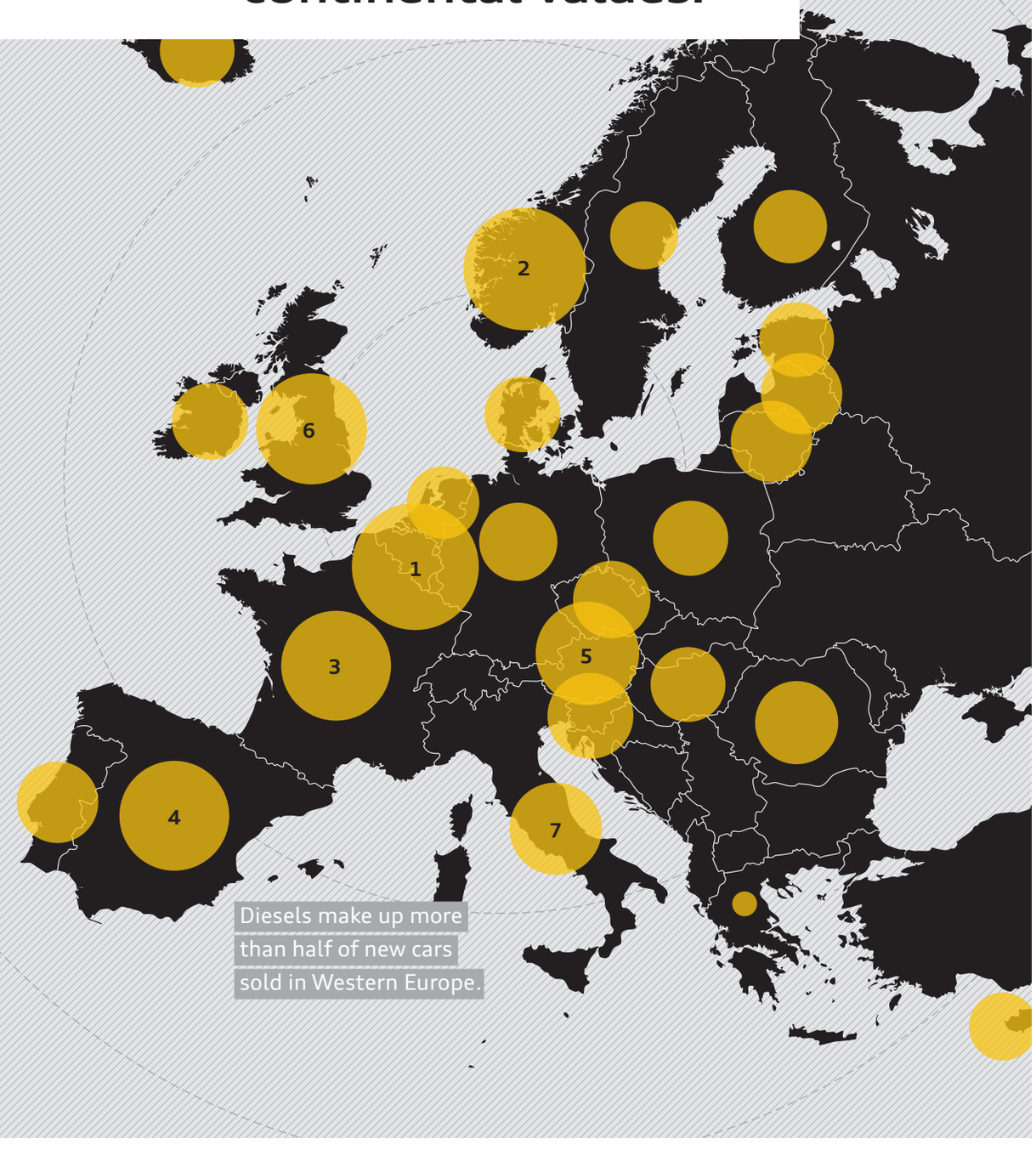
FRANCE

70.8%

62.791 million inhabitants[5]
31.709 million passenger cars on the road[5]
Third-cleanest in energy worldwide: 45.6%[8]

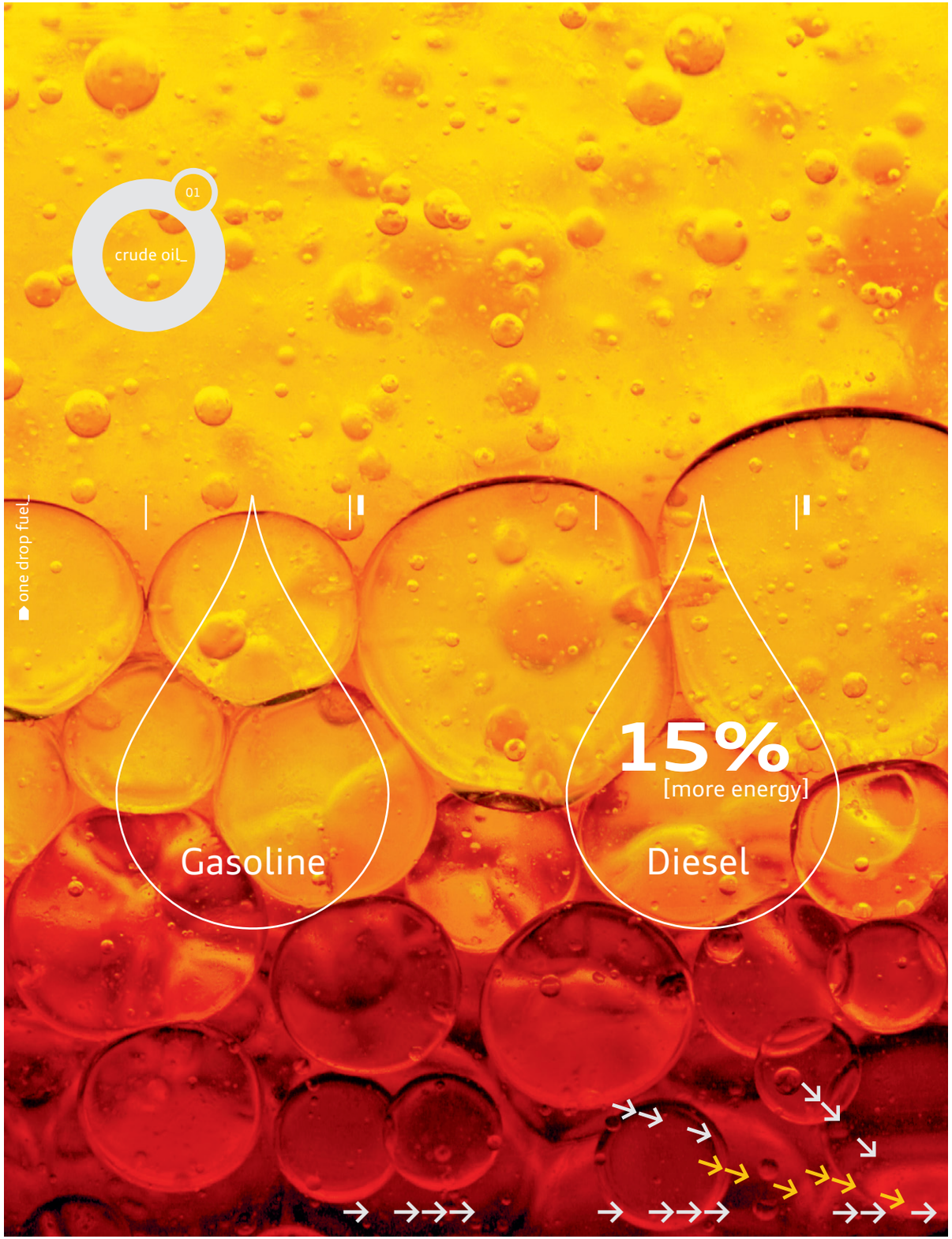
PERCENTAGE OF DIESEL CAR SALES SHARES





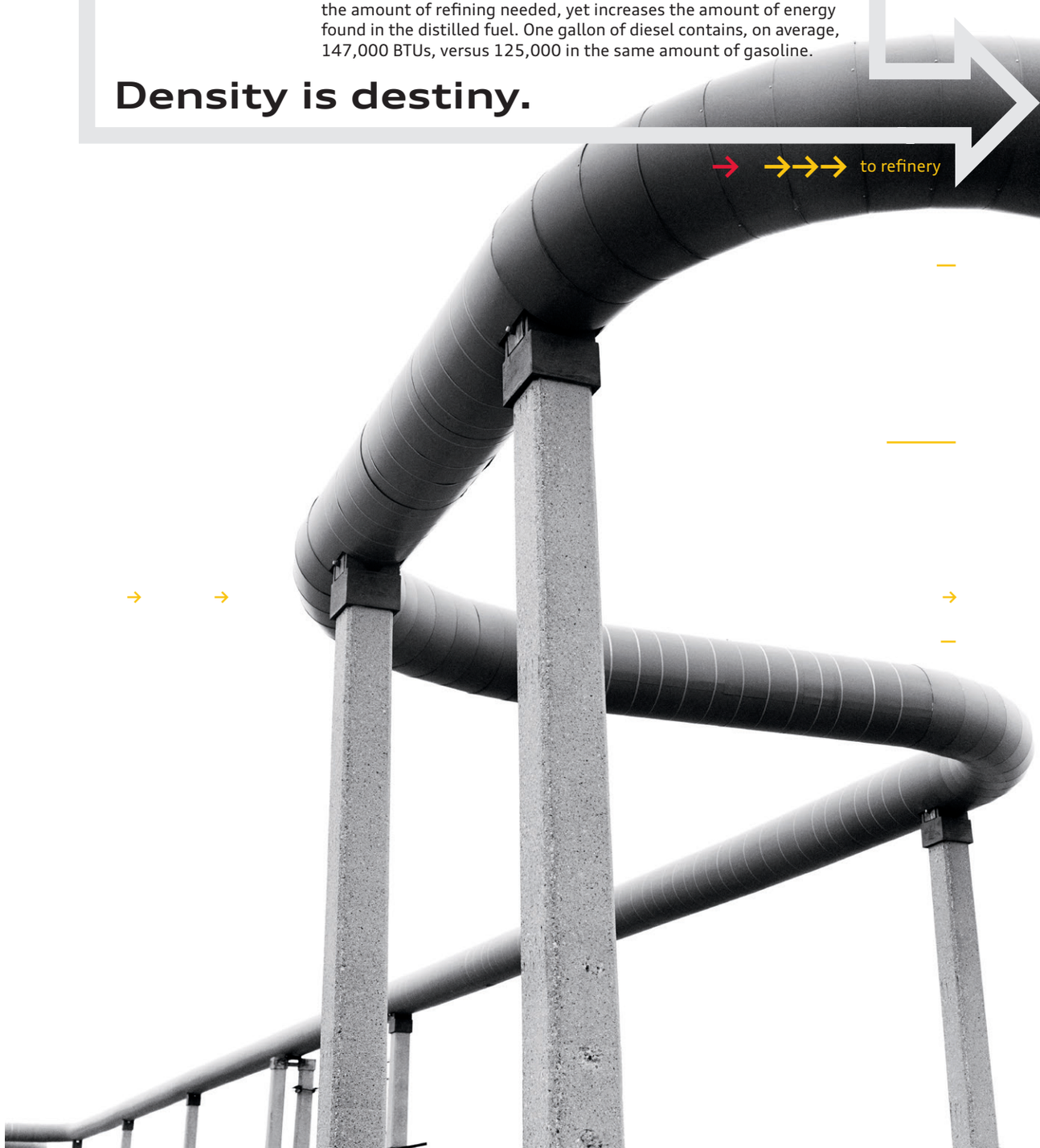
Diesels make up more than half of new cars sold in Western Europe.

1 Based on manufacturers' published specifications. 2 See www.fueleconomy.gov for EPA estimates. Your mileage may vary. 3 Data also includes Luxembourg. 4 Automotive Industry Data newsletter, www.energy.gov. 5 EU energy and transport in figures—*Statistical pocketbook, 2010.* 6 Source: World Bank, World Development Indicators 2011. 7 Highest rating based on United Nations' Human Development Index, Human Development report 2011. 8 Source: International Energy Agency (IEA).



It might seem counterintuitive, given the understanding that a drop of diesel has more inherent energy than the same amount of gasoline, but they start as the exact same thing: crude oil. Different fuels are separated by their boiling points through distillation. Increasing the boiling point reduces the amount of refining needed, yet increases the amount of energy found in the distilled fuel. One gallon of diesel contains, on average, 147,000 BTUs, versus 125,000 in the same amount of gasoline.

Density is destiny.



02 refinement process_

diesel molecule

ULSD

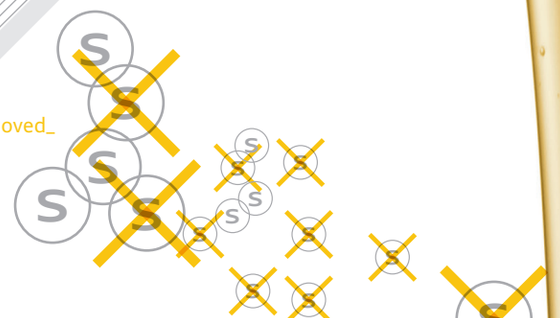
ultra-low-sulfur diesel_

Today's diesel contains 97% less sulfur than in years past.

03

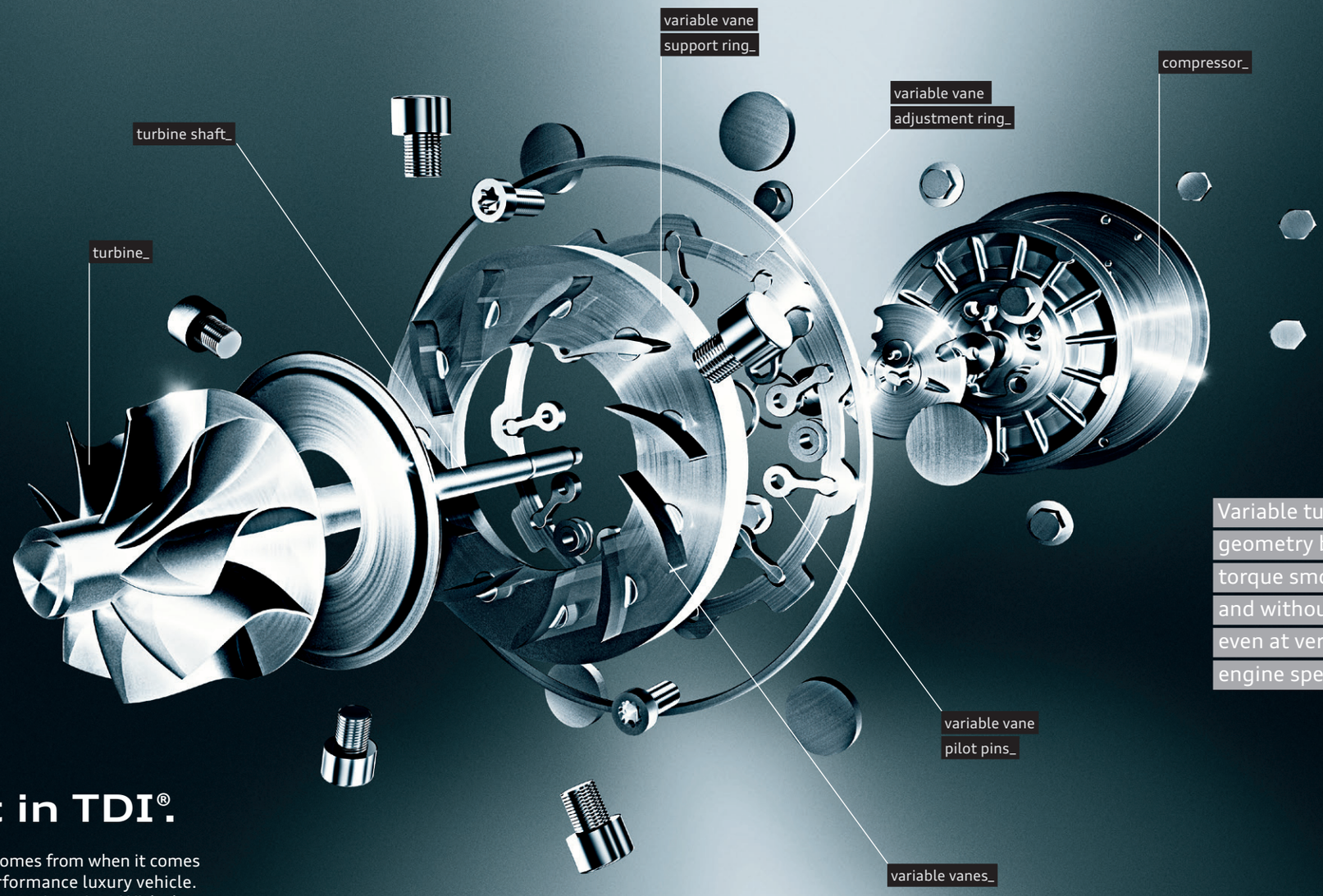
to vehicle

sulfur removed_



How to make oil less crude.

Once properly distilled, the next step for diesel fuel is a little refinement. Think of it as a finishing school for a once-notorious malcontent. First, high-sulfur distillates, like diesel or jet fuel, are heated to temperatures that exceed 600° F. In the process, the sulfur leaves the hydrocarbon molecules and binds to the hydrogen, helping separate the pollutant from the fuel. Which is all a complicated way of saying it's necessary to properly clean the fuel, making the difference between the old-school version of diesel and the ultra-low-sulfur kind that is certified for use in all 50 states.



Variable turbine geometry builds up torque smoothly and without delay, even at very low engine speed.

Why T comes first in TDI®.

Of course it's important to know where the efficiency comes from when it comes to diesel, but, ultimately, you also want to drive a performance luxury vehicle. That means power and performance born of superior engineering. With the variable vane turbocharger in our TDI® clean diesel engine, you'll never forget you're in an Audi. From a performance standpoint, the adjustable turbocharger produces pressure not only at the top end of the speed range, but also across the full spectrum of the performance range, giving you elasticity—so not only do you feel the punch of torque,[1] your passing speed between, say, 50 and 65 mph is also impressive. But, ingeniously, the engine design with its low rpm operating range also serves to help reduce fuel consumption at higher speeds, while adding a bit more acceleration with high torque at the lower end. That's how you get the T in TDI®, after all.[2]

1 Obey all speed and traffic laws. 2 See www.fueleconomy.gov for EPA estimates. Your mileage may vary.

A very small expression of power.

Sometimes power screams, asserting itself in giant numbers or a roaring engine. But discerning drivers know that power and torque at their best can be felt subtly too, in the precision of acceleration, in the balance, and in the perfect mechanical response to your desires. We like to think that you feel it every time you step into an Audi, of course, but more than that, we are confident of your response because we know the craft we put behind the delivery of power. And far from being a grand statement of horsepower, it may be best articulated by the tiny, precisely delivered droplets of diesel fuel injected directly into the combustion chambers at exactly the right time by piezo fuel injectors. A small thing, perhaps, but one that works to help enhance efficiency and reduce emissions through as many as five partial fuel injections in a single combustion cycle.[1]

Piezo injector nozzle_

05

injection_

The piezo injectors help lower the combustion noise normally associated with diesel engines, while optimizing the distribution and timing of fuel injected in the combustion chamber, helping to reduce exhaust emissions further.

1 See www.fueleconomy.gov for EPA estimates. Your mileage will vary.

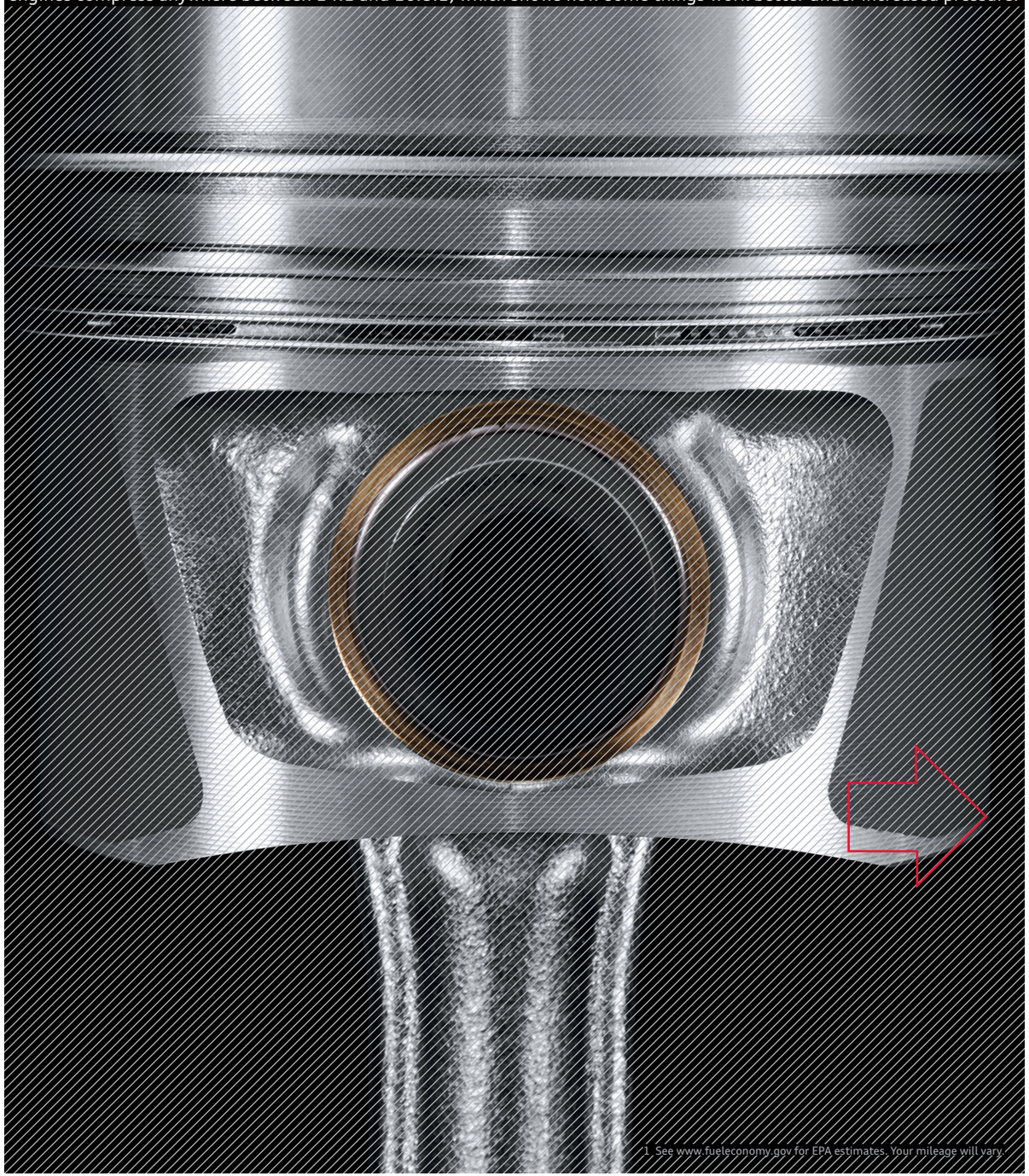
com
bustion_

06

Under Pressure

When compressed thinking turns into a big idea.

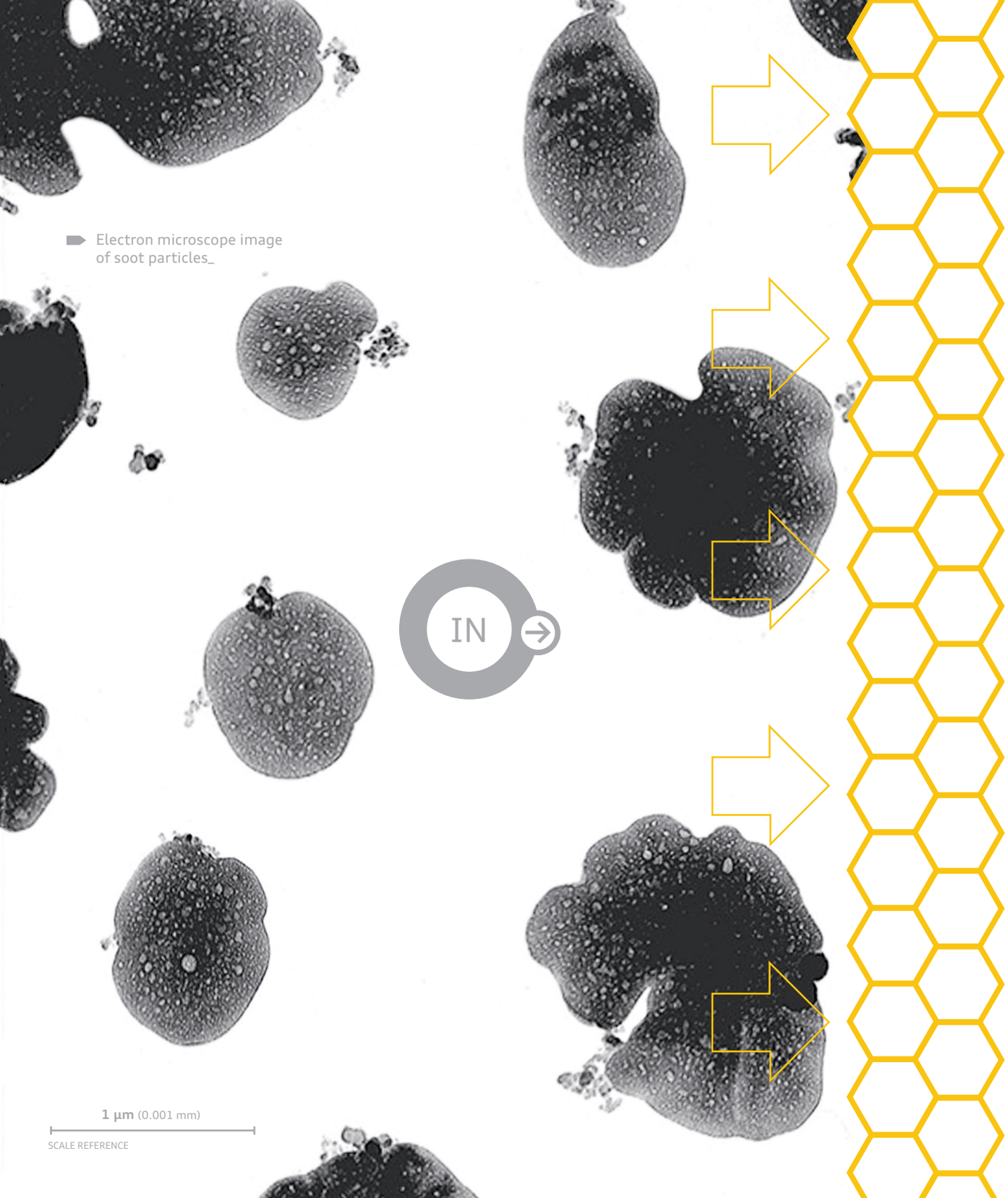
The fuel itself was named after a German engineer, but he didn't invent the fuel, he invented the engine that used it. It differs from the traditional gasoline engine in many ways, but the major difference, other than the fuel used, was the way a gas engine would mix air and fuel. With gas, the mixture would ignite with the help of a spark plug ignition system, while a diesel engine compresses air first at higher pressures, then injects the fuel. The hot, compressed air ignites the fuel without the need of an ancillary ignition system, to move the pistons. To the engineer, this high compression would lead to improved efficiency and power.[1] And he was right. The average gas engine compresses at a ratio between 8:1 and 12:1, while diesel engines compress anywhere between 14:1 and 16.8:1, which shows how some things work better under increased pressure.



1. See www.fueleconomy.gov for EPA estimates. Your mileage will vary.

Thankfully, there is always a catch.

Clean diesel, the kind that powers Audi TDI® clean diesel technology, is demonstrably cleaner than the fuel used in previous generations of diesel engines. Innovations have removed much of the pollutants, resulting in lower CO_2 emissions than even the output from comparable gasoline engines—while still delivering greater fuel efficiency.[1] So what's the catch? We have a few that further clean the diesel exhaust. The names might sound daunting—close-coupled oxidation catalysts, coated particle filters, active exhaust gas after-treatment systems utilizing AdBlue® reducing agent, but the thing they do is simple. Audi employs these systems via sensors which detect the soot level and emissions of the exhaust to work at maximum efficiency, filtering excess pollutants and particles, which allows you, and everyone else, to breathe easier about clean diesel.



Electron microscope image of soot particles_

Diesel particulate filters reduce up to 95% in diesel particle emissions.

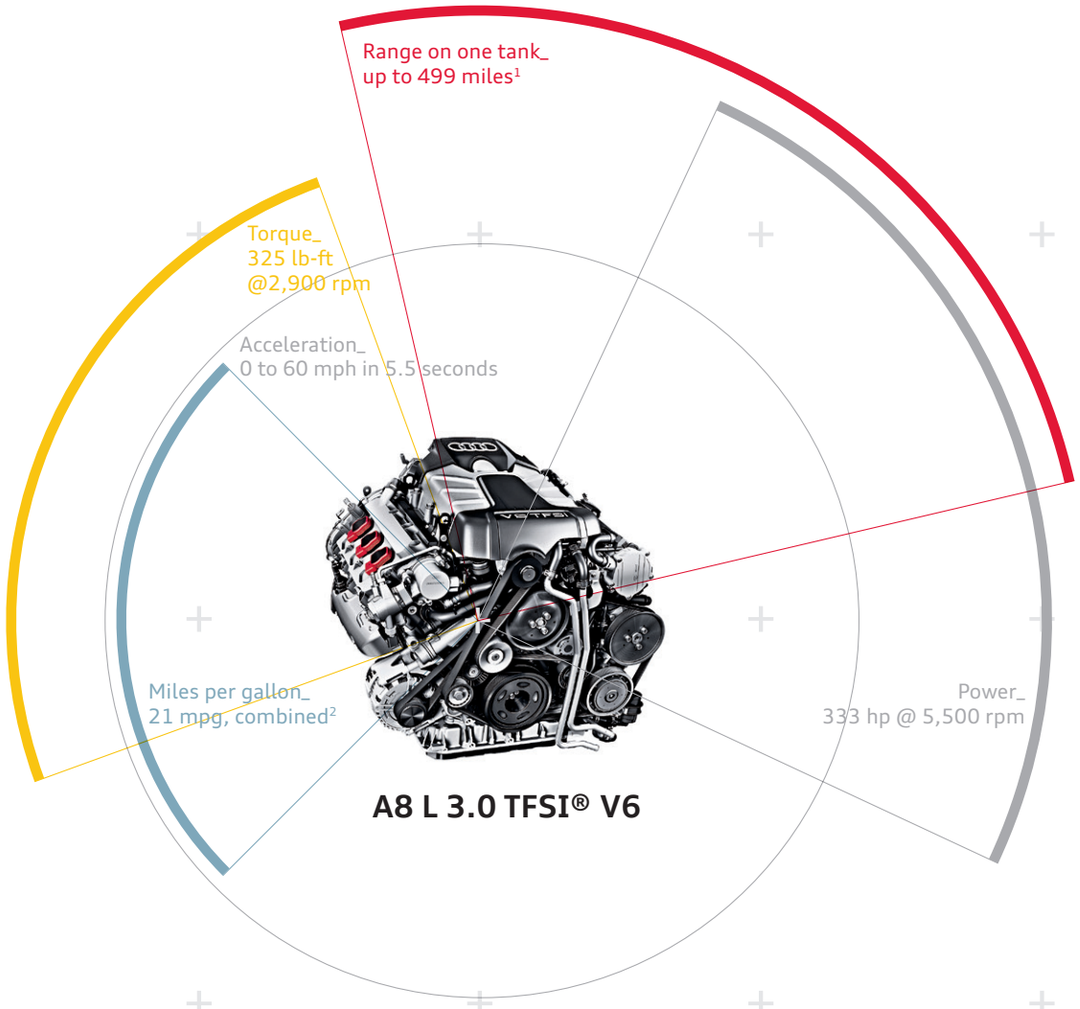
Diesel particulate filter

During normal driving conditions, the exhaust gas passes through the particulate filter. The filter then channels it through porous walls, catching larger particles to help clean the exhaust. During low engine load situations such as city traffic, exhaust gas temperature lacks the heat needed for oxidization, so fuel injection helps raise the temperature to between 1,150°F and 1,200°F to help oxidize the carbon soot before it reaches the particulate filter, further helping reduce emissions.

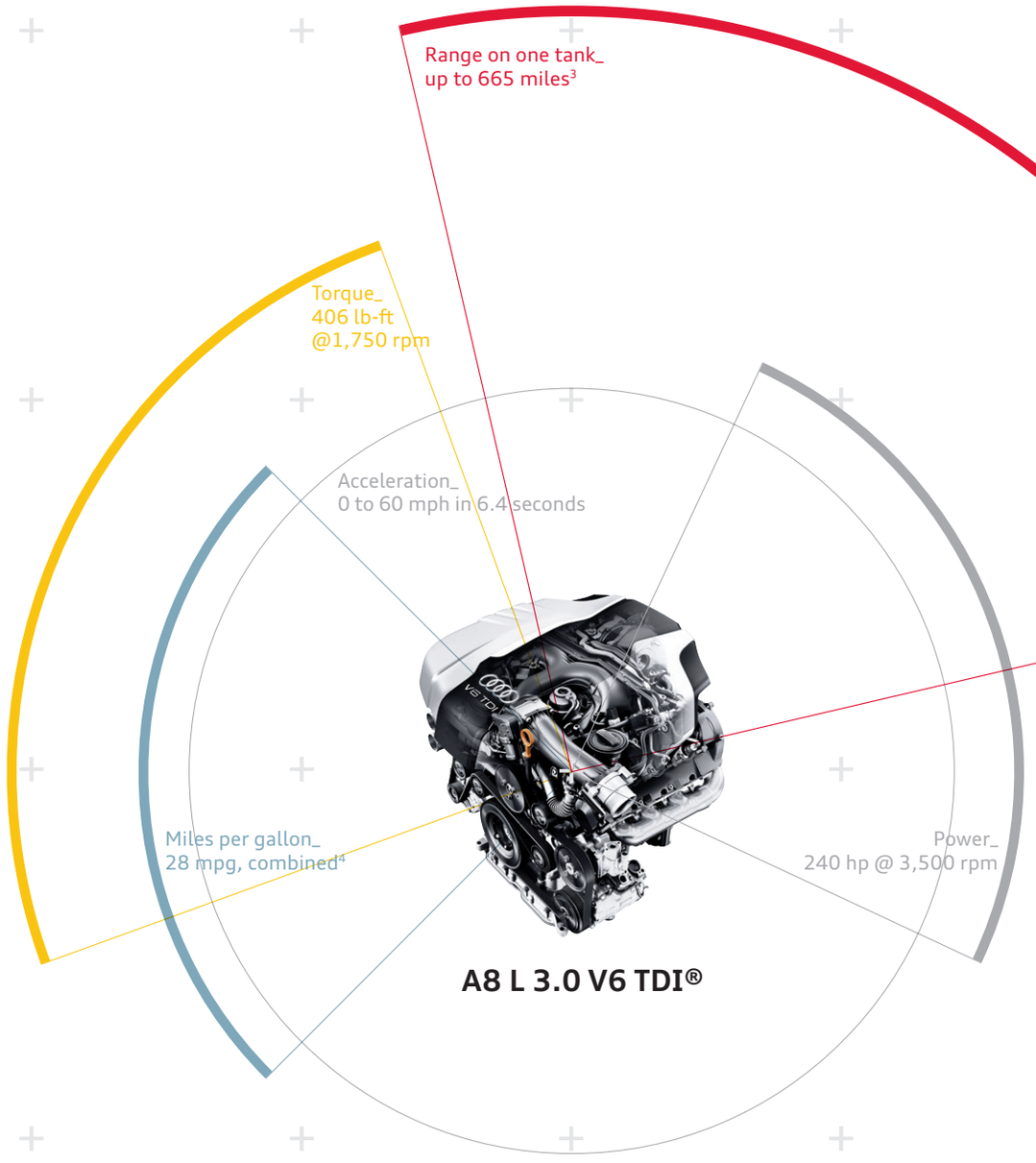
AdBlue® system

Featuring a reducing agent that is a pure, transparent solution of 32.5% urea and water, AdBlue® is a diesel exhaust after-treatment that further purifies the exhaust by helping turn NO_x emissions into harmless nitrogen and oxygen. AdBlue® is a nontoxic, noncombustible, biodegradable innovation that has helped make the use of diesel fuel in passenger cars OK in all 50 states, and has helped make diesel even cleaner.

1 See www.fueleconomy.gov for EPA estimates. Your mileage will vary.



A8 L 3.0 TFSI® V6



A8 L 3.0 V6 TDI®

It might be time to expand your horizons.

Just by looking at TDI® clean diesel, you've already broadened your horizons. Once you get behind the wheel of, say, an Audi A8 L TDI®, you might have to broaden them even further. Maybe even set a destination far beyond them. In other words, TDI® clean diesel might just be your best companion on a road trip. It'll go farther than you might even want to go. Enjoy your time between refills, great mileage and more-than-ample power. TDI® clean diesel can make any interstate your home, put almost any horizon within reach, extending your range by 150 miles or more. It's just more fuel for thought.

1 Based on 21 mpg combined (EPA estimate) and a 23.8-gallon fuel tank. Your mileage will vary.
2 18 city/28 highway/21 combined mpg (EPA estimates). Your mileage will vary.
3 Based on 28 mpg combined (EPA estimate) and a 23.8-gallon fuel tank. Your mileage will vary.
4 24 city/36 highway/28 combined mpg (2014 Audi A8 L TDI® clean diesel with eight-speed Tiptronic® automatic transmission and Audi quattro® all-wheel drive). EPA estimates. Your mileage will vary.

There’s an optimistic air about clean diesel.

Lower CO_2 emissions than those from older diesel engine technology. Longer range and better mileage than traditional gasoline models. Engineering innovation. We’re confident that you get the gist of what TDI® clean diesel delivers, its future, and its present as a powerful, iconic and efficient alternative to gasoline, hybrid or all-electric vehicles.[1] But Audi wants you to never forget the real luxuries of ownership. There are no compromises. This is, after all, an Audi. That means you don’t just get precision handling, you get the performance and grip of Audi quattro® all-wheel drive. You don’t just get great mileage, you get the added efficiency of Audi ultra® lightweight technologies. This is where you feel the need to get in one, celebrate the possibilities of clean diesel performance by putting the windows down and discover just how bright the future can be.

1 See www.fueleconomy.gov for EPA estimates. Your mileage will vary.

When it comes to luxury, we'd only change one thing.

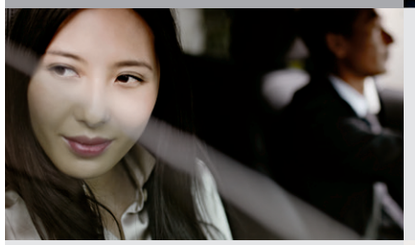
It's true. The interior of an Audi TDI® clean diesel vehicle isn't exactly the same as its gasoline equivalent. They have slightly different tachometers to gauge diesel's peak power at lower revs. But if you can live with that difference, you'll find that an Audi interior is an Audi interior. That means unmatched fit and finish. A total commitment to craftsmanship and quality that you can feel in each stitch in the supple leather and every polished inch of your inlays. That means rich wood options. Or choosing a glistening aluminum trim. It means you will want to explore every inch of the seat with your hands and will hate to let go of the steering wheel when it's time to leave. It means compromising on taste or style exactly as much as you would on performance—which is to say, not at all.

More fuel for thought about diesel.

We've been working on diesel for 40 years now. In fact, half of all the vehicles we sell worldwide are diesels, so it's second nature to us. Still, we know that America is only now coming around to the benefits of TDI® clean diesel, and we're overcoming the misperceptions. But just in case there is more work to be done, we'd like to add some fuel for thought. Yes, diesel is readily available at fueling stations, in fact, you can find a diesel pump at more than 52% of all stations nationwide[1]—and at a higher percentage along Interstates and major highways. Yes, there are even apps and available Audi connect®, of course, for finding them.[2] No, you'll never have to worry about replacing a spark plug again. Yes, Audi TDI® clean diesel vehicles can be purchased in all 50 states. No, there is no particular problem starting them in normal cold weather. Yes, we know, there's always more to say about it. But we'd like you to try one for yourself and let us know if you have any other questions. #fuelforthought

I want fuel accessibility_

more than 52% of U.S. gasoline stations offer diesel fuel.



I care for the environment_

diesel engines emit fewer CO_2 emissions than traditional gasoline engines.

I want to help the U.S. conserve energy sources_

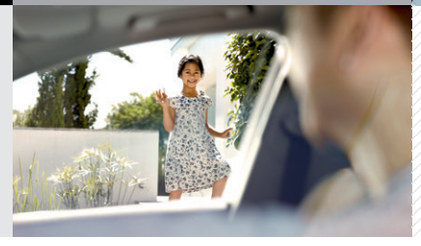
if 1/3 of us drive a TDI® vehicle, we'd use millions fewer barrels of oil a day.

I want efficient luxury[3] without compromise_

Audi has the largest offering of diesel models in the luxury class.[4]

I want more time with my family_

with diesel, you will make up to 20% fewer visits to the pump.



1 Source: U.S. Bureau of Census (2010). 2 Always pay careful attention to the road, and do not drive while distracted. The features and technologies discussed above are optional, may require an additional subscription with separate terms and conditions, and should be used only when it is safe and appropriate. The Wi-Fi hotspot feature is intended for passenger use only. 3 See www.fueleconomy.gov for EPA estimates. Your mileage will vary. 4 Based on manufacturers' published specifications.

A6 TDI®

ENGINE	DRIVETRAIN	FUEL ECONOMY
3.0-liter TDI® clean diesel V6 with 240 hp and 428 lb-ft of torque with AdBlue® exhaust after-treatment	Eight-speed Tiptronic® automatic transmission and Audi quattro® all-wheel drive	24 city/38 highway/ 29 combined[3]

A7 TDI®

ENGINE	DRIVETRAIN	FUEL ECONOMY
3.0-liter TDI® clean diesel V6 with 240 hp and 428 lb-ft of torque with AdBlue® exhaust after-treatment	Eight-speed Tiptronic® automatic transmission and Audi quattro® all-wheel drive	24 city/38 highway/ 29 combined[3]

Audi TDI® clean diesel sedans

So seductive and stylish, the word “sedan” seems a bit small. Instead, the Audi A6, A7 and A8 L TDI® clean diesel Sedans should be described in somewhat bolder terms: spectacular, perhaps? Stately? Stunning? To a vehicle, they share the Audi DNA throughout. This is an A6, just as you know it, loaded with technology, effortlessly powerful and endlessly nimble. The A7 is every bit the iconic style leader, cornering with confidence and effortless precision.

The A8 L, of course, is still the executive’s choice, the pinnacle of the automaker’s craft, a statement of cultivated tastes and well-defined performance—as well as a vehicle that provides better mileage than hybrids in the same segment.[1] These aren’t simply sedans, they are ultra-efficient luxury diesel sedans, proudly wearing the four rings and TDI clean diesel designation.[2] Collectively, they are a signature achievement.

A8 L TDI®

ENGINE	DRIVETRAIN	FUEL ECONOMY
3.0-liter TDI® clean diesel V6 with 240 hp and 406 lb-ft of torque with AdBlue® exhaust after-treatment	Eight-speed Tiptronic® automatic transmission and Audi quattro® all-wheel drive	24 city/36 highway/ 28 combined[3]

1 Based on EPA estimates for 2013 Mercedes Benz S400 hybrid (19 city/25 hwy mpg) and Audi A8L TDI clean diesel (24 city/36 hwy mpg) models. Your mileage will vary. 2 See www.fueleconomy.gov for EPA estimates. Your mileage will vary. 3 EPA estimates. Your mileage will vary.

Audi TDI® clean diesel SUVs

Efficiency is expected to carry more with the Audi Q5 and Q7 TDI® clean diesel models. In fact, they carry even more than families or camping gear, they carry the future. It's a versatile one, one that combines powerful torque with traditional SUV convenience, but never one that forgets its luxury lineage. Their diesel engines provide the torque which helps deliver powerful towing performance. They teem with thoughtful touches and innovations. Standard leather seating surfaces, available Audi connect®,[1] rich decorative wood inlays and available Audi accessories can bring out even more in your drive. From the five-passenger Q5 to the three-row, seven-passenger Q7, these incredibly efficient SUVs elevate luxury diesel and make it something iconic—and more.[2]

Q5 TDI®

ENGINE	DRIVETRAIN	FUEL ECONOMY
3.0-liter TDI® clean diesel V6 with 240 hp and 428 lb-ft of torque with AdBlue® exhaust after-treatment	Eight-speed Tiptronic® automatic transmission and Audi quattro® all-wheel drive	24 city/31 highway/ 27 combined[3]

Q7 TDI®

ENGINE	DRIVETRAIN
3.0-liter TDI® clean diesel V6 with 240 hp and 406 lb-ft of torque with AdBlue® exhaust after-treatment	Eight-speed Tiptronic® automatic transmission and Audi quattro® all-wheel drive

1 Always pay careful attention to the road, and do not drive while distracted. The features and technologies discussed above are optional, may require an additional subscription with separate terms and conditions, and should be used only when it is safe and appropriate. The Wi-Fi hotspot feature is intended for passenger use only. 2 See www.fueleconomy.gov for EPA estimates. Your mileage will vary. 3 EPA estimates. Your mileage will vary.